Limington Quadrangle, Maine

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BEDROCK MAPS AND THEIR USES

The geologic map at left shows features of the bedrock, the solid rock that makes up the earth's crust. The overlying sediment, which is shown on surficial geologic maps, is disregarded here. Symbols on the map show locations where bedrock is exposed at the land surface. Closely related or distinctive rock types are grouped together into formations and other rock units (see map explanation). Boundaries between units are shown by either solid, dashed, or dotted lines on the map to indicate how well their locations are known. A widespread sand and gravel deposit in the eastern part of this quadrangle completely covers the bedrock, so the bedrock geology there is poorly known.

In most of Maine the bedrock is within a few tens of feet below the ground surface. Any significant subsurface activity, such as excavating for building foundations, installing bridge footings or power poles, quarrying gravel, or drilling water wells may encounter bedrock. A bedrock map is the geologist's prediction of what kind of rock will be encountered below the surface based on observed surface exposures. Quarries, whether for dimension stone such as granite or for crushed rock aggregate with particular strength characteristics, are best sited in appropriate rock types. Exploration geologists or mineral collectors looking for metal ores, industrial minerals, or gemstones may be interested in specific rock types likely to contain the minerals of interest. Engineers planning roads or transmission line routes may use bedrock maps in conjunction with surficial geologic maps to see where valleys, ridges, and hills are controlled structurally by shallow bedrock rather than by unconsolidated deposits. Soil chemistry, important to agriculture and natural plant ecology, is related to bedrock composition because rock weathering contributes to soil formation. Water from wells drilled into bedrock may contain dissolved iron, manganese, calcium, or other undesirable constituents that occur naturally in higher concentrations in some rocks than in others. Groundwater flow in bedrock, relevant to water supply and contaminant transport issues, is controlled in a complicated way by the rock structure, including lithologic layering, metamorphic foliation, folds, dikes, and fractures, any of which may be indicated by symbols on the map. The distribution of rock units, their geometric relationships on the map, and the map explanation together indicate the origin of each unit and the sequence of geologic events that occurred in the map area. This provides a regional context that allows information from one area to be applied to another if the bedrock is sufficiently similar.

BEDROCK GEOLOGY OF THE LIMINGTON QUADRANGLE

Stratified Rocks

The stratified, or layered, rocks of the Limington quadrangle are metamorphic rocks, primarily schist and granofels. Schist is a rock composed of small, flat minerals such as mica that are aligned to give the rock a sheet-like structure so that it splits easily. Granofels is a more uniform rock made up of equant minerals such as quartz and feldspar, which are not elongated in any particular direction so that the rock breaks into angular pieces. A particular schist or granofels may be distinguished by mineral content, grain size, or other characteristics. For example, a granofels made up of diopside and plagioclase, minerals which contain calcium and silica, would be called a calc-silicate granofels.

The stratified rocks were originally sediments that accumulated in an ocean basin during the Silurian to Early Devonian Periods (see Geologic Time Scale below). Geologic processes gradually turned the sediments into rock in a way that preserved many layers and other sedimentary features, but in a modified form. Beds of muddy sand and silt became granofels and schist of the Rindgemere Formation (**Photo 1**). Alternating beds of clean, quartz sand and fine, gray mud became quartzite and schist of the Libby Mountain member (**Photo 2**). Thin deposits of organic-rich, anoxic, sulfidic mud became rusty-weathering schist (unit **Srs)** of the Rindgemere (**Photo 3**). Layers of feldspathic, argillaceous sandstones and siltstones became biotite granofels of the unnamed granofels unit (**SDgf**).

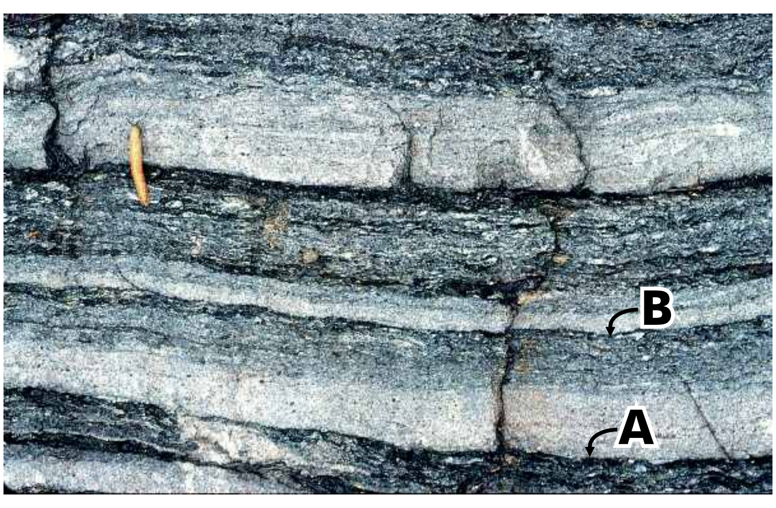

Photo 2. Alternating white quartzite and gray schist characteristic of the Libby Mountain member of the Rindgemere Formation. Graded beds indicate the beds are stratigraphically younger toward the top of the photo (northeast). Quartzite at the base of a bed rests in sharp contact against schist at A. The rock becomes gradually more schistose upward through the bed to where schist is in sharp contact with the next quartzite bed at B. Slug for scale. *Outcrop 8000 feet N55W of Limington.*

Photo 1. Layered schist and granofels. The rock has broken parallel to thin schist layers but irregularly across the granofels layers in steps. Brown-weathering schist surfaces sparkle due to reflective mica grains. *Rindgemere Fm; road cut SE side of Rt. 11, 1.3 miles SW of Limington.*

Photo 3. Rusty-weathering schist with dark purple-black weathered crust. The rust comes from weathering of iron sulfide minerals in the rock. *Sulfidic schist unit (**Srs**) of the Rindgemere Formation; 8600 feet N50W of Limington.*

Metamorphic and Structural Features

In the Devonian and Carboniferous Periods, New England was geologically active. Rocks now at the surface in southern Maine were then at depth, subjected to temperatures over 500 degrees Centigrade and pressure at least 3000 times atmospheric, suggesting minimum depths of 5 to 6 miles beneath the surface. Over time, these conditions caused metamorphism (literally, a change in form) of the rocks. Pre-existing layers were distorted into various folded shapes (**Photos 4, 5**). Parallel planes of cleavage developed which changed the rock structure (**Photo 6**). Metamorphic minerals which had grown in response to the heat, were themselves deformed (**Photo 7**). The geologic history included a complex sequence of deformation and metamorphic mineral growth. Symbols on the map indicate the variety of fold orientations and structural characteristics from place to place in the quadrangle.

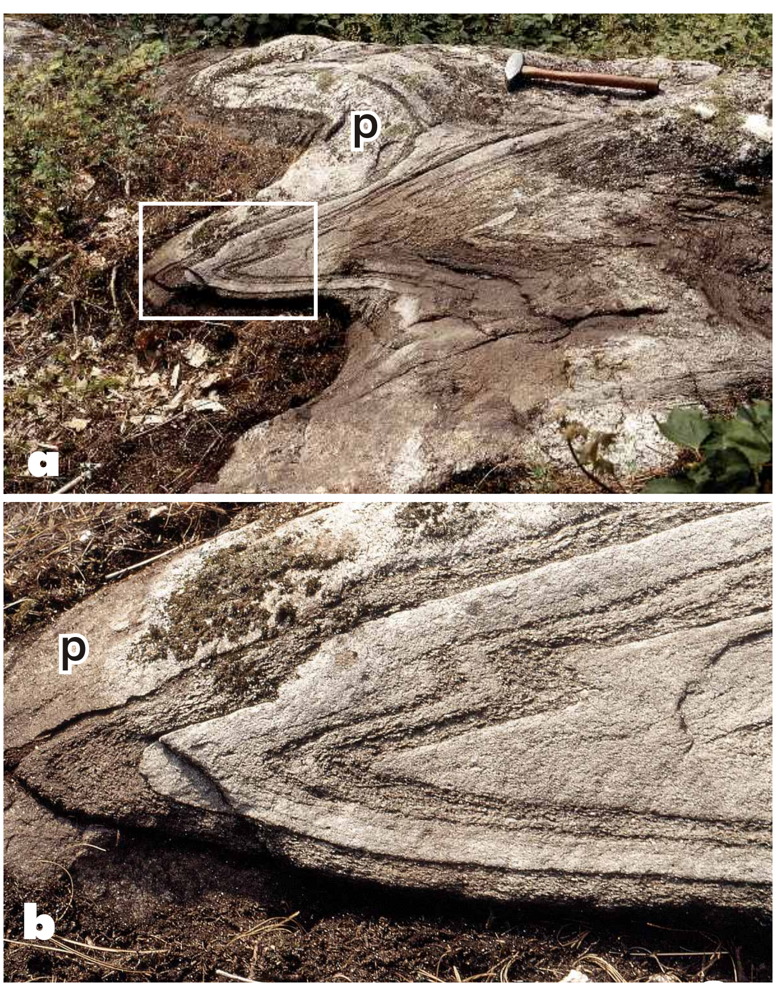

Photo 4. Upright minor folds in bedded schist and quartzite. Prominent layer along top of outcrop is a distinctive slightly pinkish, garnet + quartz rock that occurs in beds at many places in the Libby Mountain member. *Outcrop 50 feet east of Rt. 117, 1.1 miles north of Limington.*

Photo 5a. Folded layers of schist and quartzite. Pegmatite intrusion (p) is also folded. **b.** Close-up showing that layers continue smoothly around the fold without being broken. Layers are thicker in the hinge than on the fold limbs. *Libby Mountain member of the Rindgemere Formation; 6500 feet N60W of Limington.*

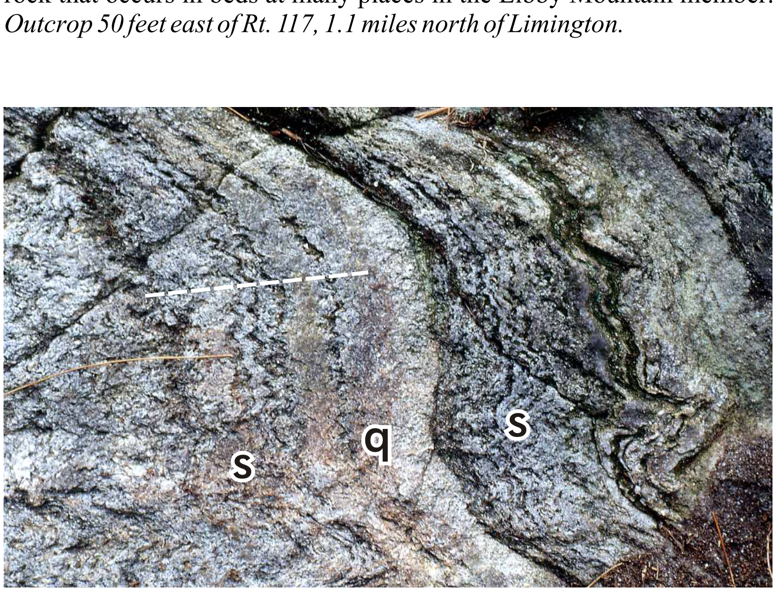

Photo 6. Crenulation cleavage. Small crenulation folds deform layering and schistosity. Axial surfaces of crenulations are aligned through the rock approximately parallel to the dashed line. Note that crenulations are more pronounced in schist (s) than in quartzite (q). *Libby Mountain member of the Rindgemere Formation; 6200 feet N58W of Limington.*

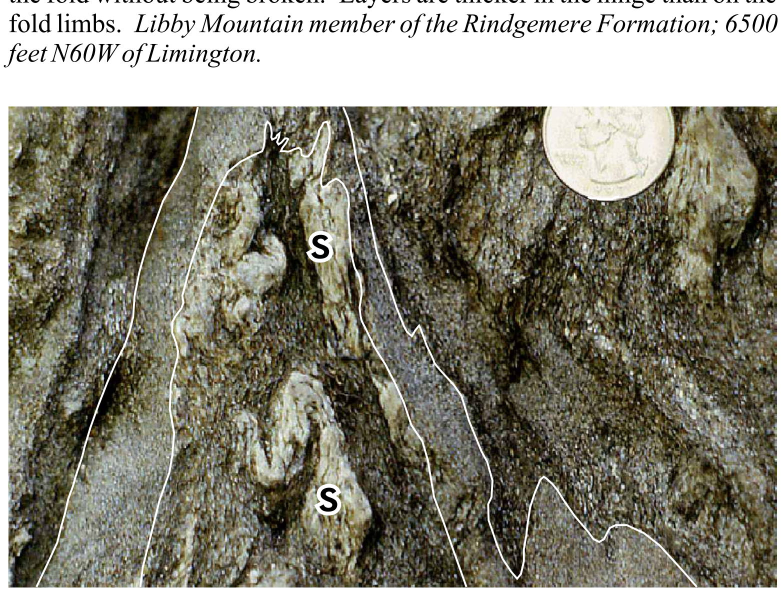

Photo 7. Folded sillimanite schist. A light-colored granofels bed (highlighted) outlines a fold. Clumps of metamorphic sillimanite (s) have been folded into "hook" shapes along with the bedding. This demonstrates that some folding occurred after the metamorphism. *Rindgemere Formation; 100 feet east of road, 0.7 mile north of West Hollis.*

Intrusive Rocks

During and after metamorphism, melting occurred in parts of the crust to produce magma (molten rock). The magma forced its way into rocks of the region, following or cutting across the pre-existing layers. It cooled slowly underground to produce coarse-grained igneous rocks such as granite and pegmatite. None of the granite bodies in the Limington quadrangle have been dated, but similar granites in southern Maine range from Devonian to Carboniferous age.

The youngest rocks of the quadrangle are thin dikes of black, fine-grained igneous rock (**Photo 8**), shown on the map by red symbols. They formed when magma intruded into relatively cool, solid rock along straight fractures. These dikes formed during the Mesozoic Era when Europe and Africa were rifting away from North America to begin opening the modern Atlantic Ocean. There is a large dike, locally containing gabbro, at the south edge of the map. Less common quartz veins and abundant brittle fractures (**Photo 9**) are probably also Mesozoic.

Photo 8. Dark gray Mesozoic dikes cutting Paleozoic granite. Their fine grain size indicates that the dike rocks crystallized rapidly from magma. Cross-fractures within the dikes, called columnar joints, form soon after intrusion when the dikes cool and contract. *At Limington Rapids Rest Area, west shore of Saco River south of Rt. 25.*

Photo 9. Quartz vein in Paleozoic granite. Brittle fractures, or joints, are closely spaced in the quartz vein and widely spaced in the massive granite. *About 100 feet south of **Photo 8**.*

Photos and text by Henry N. Berry IV.

GEOLOGIC TIME SCALE

Geologic Age		Absolute Age*
Cenozoic Era		0-66
Mesozoic Era	Cretaceous Period	66-144
	Jurassic Period	144-208
	Triassic Period	208-245
Paleozoic Era	Permian Period	245-286
	Carboniferous Period	286-360
	Devonian Period	360-415
	Silurian Period	415-443
	Ordovician Period	443-495
	Cambrian Period	495-545
Precambrian time		Older than 545

* In millions of years before present.

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